

# Clinical and Radiographic Evaluation of *Aloe vera* vs Formocresol as a Pulpotomy Medicament in Primary Molars: A Double Blinded Randomized Controlled Trial

Divya Subramanyam<sup>1</sup>, Sujatha Somasundaram<sup>2</sup>

## ABSTRACT

**Aim:** The aim of this clinical trial is to compare the clinical and radiographic success of *Aloe vera* and formocresol (FC) as a pulpotomy medicament in primary molars.

**Materials and methods:** A total of 72 asymptomatic or symptomatic vital primary molars were selected and were assigned to two groups: group I: Buckley's FC, group II: *Aloe vera* gel. The clinical and radiographic success were evaluated using Zurn and Seale criteria. The data were statistically analyzed using the Chi-square test.

**Results:** At three and 6 months follow-up, the clinical success rate of *Aloe vera* and FC was equally effective. *Aloe vera* showed a higher radiographic success rate compared to FC ( $p > 0.05$ ). At 6 months follow-up, FC showed a higher radiographic success rate compared to *Aloe vera* ( $p > 0.05$ ).

**Conclusion:** The clinical and radiographic success of both groups were equally effective at the end of 6 months follow-up. *Aloe vera* can be considered as an alternative pulpotomy medicament to FC. But, further long-term follow-up studies and histological studies are required.

**Keywords:** Formocresol, Primary teeth, Pulp therapy, Pulpotomy.

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## INTRODUCTION

Primary dentition serves as a guide for the eruption of permanent teeth. Preservation of deciduous teeth until its physiological or natural exfoliation in the dental arch is of utmost importance for the maintenance of space for the successors and to aid in the proper growth and development of the dental arch.<sup>1</sup> Premature loss of primary teeth affects the aesthetics of young children, which impairs the quality of life of children. In early childhood, dental caries remains a significant public health challenge for many pediatric dental practitioners.<sup>2</sup> In India, the prevalence of dental caries in children below 5 years of age is 48.11%.<sup>3</sup> Early childhood caries (ECC) progress very rapidly beginning soon after the eruption of the teeth leading to ultimate destruction or loss of teeth.

Preserving the pulp vitality is necessary for healthy functioning of the primary teeth, which in turn maintains the integrity of the dental arches.<sup>4</sup> The success of vital pulp therapy depends on adequate blood supply, obtaining hemostasis, severity of inflammation, disinfection of the exposure site, antibacterial properties, and adequate coronal seal of the pulp dressing materials.<sup>5</sup>

Based on the available literature, pulpotomy is considered the most ideal and appropriate treatment for cariously exposed, asymptomatic vital primary teeth with good success rate.<sup>6</sup> The goal of pulpotomy is to preserve the vitality of the radicular pulp and protect the pulp from further insult and promote healing.<sup>7</sup> Pulpotomy is defined as a procedure in which coronal pulp is amputated, and the remaining radicular pulp is treated with a medicament to preserve the health of the pulp.<sup>8</sup> Pulpotomy is indicated in a primary tooth with a deep carious lesion when removal of carious lesion results in mechanical or carious pulp exposure without any radicular pathology (AAPD). Contraindications of pulpotomy include periapical pathology, swelling, root resorption, pulp calcifications, or excessive bleeding from amputated root

<sup>1</sup>Department of Pediatric and Preventive Dentistry, Asan Memorial Dental College and Hospital, Chengalpattu, Tamil Nadu, India

<sup>2</sup>Department of Pediatric and Preventive Dentistry, Saveetha Dental College, Chennai, Tamil Nadu, India

**Corresponding Author:** Divya Subramanyam, Department of Pediatric and Preventive Dentistry, Asan Memorial Dental College and Hospital, Chengalpattu, Tamil Nadu, India, Phone: +91 9003226380, e-mail: smiley.divya24@gmail.com

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stumps for more than 5 minutes.<sup>9</sup> There should not be any postoperative external root resorption or furcal radiolucency (AAPD 2014). If there is a presence of pain, swelling, fistula, periapical or interradicular radiolucency and pathologic internal or external root resorption following pulpotomy, it is considered as failure.<sup>10</sup>

Pulpotomy modalities can be classified based upon treatment objectives into three categories, which are devitalization, preservation, and regeneration.<sup>11</sup>

The first approach in pulpotomy of deciduous teeth is the devitalization approach, which was designed to mummify the tissue completely.<sup>12</sup> It includes formocresol (FC), electrosurgery, and laser. Ideal pulp dressing material should be<sup>13</sup>

- Bactericidal
- Possess anti-inflammatory potential to control the preexisting inflammation

- Harmless to the pulp and surrounding tissues
- Promote healing of the radicular pulp
- Should not interfere with physiologic root resorption
- Preserve the radicular pulp without any clinical or radiographic symptoms.

The ideal pulp dressing material after pulpotomy should leave radicular pulp vital, healthy, and enclosed within an odontoblast-lined dentine chamber.<sup>14</sup> It should maintain an adequate vascular supply of the radicular pulp for the active formation of dentin bridge by odontoblasts.<sup>15</sup> Over the past many years, numerous agents have been used as a pulpotomy medicament having its own merits and drawbacks.<sup>16</sup> Formocresol was introduced by Buckley in 1905. It was reemphasized by Sweet in 1932 as a pulpotomy medicament in primary teeth. Buckley's FC consists of 19% formaldehyde, 35% cresol, 17.5% glycerin, and water. Glycerine is added to prevent the polymerization of formaldehyde to paraformaldehyde.<sup>17</sup> The presence of paraformaldehyde causes clouding of the solution.

Formocresol prevents tissue autolysis by binding to the protein. It inhibits the enzyme, which further breaks down the pulp tissue resulting in "fixation" of the remaining radicular pulp tissue.<sup>18</sup> It is a bactericidal agent that fixes the pulp tissue. Formocresol is considered the gold standard pulpotomy medicament by which all new modalities were compared.<sup>19,20</sup> For the past 70 years, it has been the most popular pulpotomy medicament in primary teeth with 70–98% clinical success.<sup>21,22</sup>

For many years, there has been controversy over the use of FC regarding its mutagenicity, carcinogenicity, and immune sensitization.<sup>23</sup> In June 2004, the International Agency for Research on Cancer (IARC) classified formaldehyde as carcinogenic to humans. A number of animal studies have demonstrated that chromosomal, as well as carcinogenic alterations in the epithelium, occur due to the exposure to FC (IARC, 2004). It can cause nasopharyngeal cancers in humans, and when absorbed systemically result in hypoplastic or/and hypomineralization defects in permanent successors.<sup>24</sup>

To overcome the drawbacks of FC, many alternative medicaments have been used, which are more biocompatible than FC, such as ferric sulfate, glutaraldehyde, calcium hydroxide, and mineral trioxide aggregate.<sup>25</sup> In spite of the disadvantages, none of the other medicaments have met the same degree of effectiveness and success rates as FC.<sup>26</sup>

These synthetic pulpotomy medicaments have their respective advantages and disadvantages, this has led to search of newer pulpotomy medicament, which has a less caustic effect and has a good antibacterial effect.

Currently, the field of dentistry has taken a pursuit towards ethnopharmacology. There has been the use of herbal agents for the treatment of many infectious diseases. Over the last few years as it possesses good antibacterial and anti-inflammatory properties. Increased utilization of plant medicines in developing countries became a policy of WHO in 1970. In the view of development of new medicaments to replace the standard pulp dressing material, herbal medicine has been on the rise in the last few years.

Herbal medicinal products such as *Aloe vera*, *Elaeagnus angustifolia*, Ankaferd BloodStopper, turmeric, and *Copaifera langsdorffii* oil is used as a pulpotomy medicament because of their low cytotoxicity compared to standard synthetic materials.<sup>27</sup>

*Aloe vera* is a traditional medicine that is used as a therapeutic agent. Every part of the plant has been used in the treatment of various infections. It has anti-inflammatory, antifungal, antibacterial, antifungal, analgesic, and wound healing property.<sup>28</sup>

Studies have reported that *Aloe vera* showed good clinical and radiographic success when used as an obturating material in primary teeth.<sup>29</sup>

Several *in vitro* studies have been done using *Aloe vera* as a pulp dressing material proving its anti-inflammatory and wound healing property. Only one study was found in the literature evaluating the clinical success of *Aloe vera* as a pulpotomy medicament for a period of 2 months. Histological analysis of the teeth treated by *Aloe vera* showed intact radicular pulp, which retained the vitality of the teeth.<sup>30,31</sup> The clinical and radiographic effectiveness of *Aloe vera* gel compared to gold standard medicament like 1:5 dilutions FC in primary dentition is yet to be established in clinical studies.

So, this clinical trial aims to evaluate and compare the clinical and radiographic success of *Aloe vera* and FC as a pulpotomy medicament in primary molars.

## MATERIALS AND METHODS

The study approval was obtained by the Institutional Review Board, Saveetha Dental College, ref. no: SRB/SDMDS15PED4. Clinical procedure was explained. Informed consent was got from parents/caregivers prior to the beginning of the study. A total of 72 teeth requiring pulpotomy in primary molars were selected for this randomized controlled clinical trial from OP, Department of Pediatric and Preventive Dentistry. Inclusion criteria for this clinical trial were as follows: primary molars with carious and mechanical pulp exposure healthy children between the age group of 4 years and 10 years, asymptomatic/symptomatic primary molars with a deep carious lesion approximating or involving the pulp, intermittent pain during mastication, no clinical and radiographic evidence of inflamed pulp, pulp degeneration, such as excessive bleeding, mobility, abscess, sinus and fistula, teeth should be restorable after pulpotomy, absence of interradicular radiolucency, internal or external root resorption, at least two-thirds of the root length available. Exclusion criteria includes children with systemic illness, presence of persistent lingering pain during night time, tenderness to percussion, presence of abscess, sinus or fistula, extensive loss of crown structure, presence of pathological mobility, presence of interradicular bone loss, presence of internal or external root resorption, extensive loss of crown structure, teeth close to natural exfoliation. Seventy-two teeth were randomly assigned to one of the two intervention groups: group I: Buckley's FC, group II: *Aloe vera* gel. Pulpotomy procedure was carried out by the pediatric dentist. Single visit pulpotomy procedure was carried out. Statistical analyses were performed using SPSS 20.0 software (SPSS Inc., Chicago, IL, USA). Statistical significance was set at  $p < 0.05$ .

## Clinical Procedure

Preoperative radiograph was taken before the procedure. An aseptic technique was followed throughout the treatment. Topical anesthetic gel was applied, followed by administration of local anesthesia containing 2% lignocaine in 1:200,000 adrenaline. All the teeth were isolated with a rubber dam, and access was gained to the pulp with a sterile high speed no. 4 or no. 6 diamond round bur mounted in an air rotor with water spray to expose pulp chamber. The roof of the pulp chamber was removed with a non-end-cutting bur followed by excision of the coronal portion of the pulp using a sterile sharp spoon excavator. After the coronal pulp was amputated, pulp chamber was irrigated with normal isotonic saline to remove any remaining dentinal debris. Hemostasis was achieved with a moistened cotton pellet gently pressed against the

amputated pulp stumps in both the groups for 5 minutes. If there is absence of adequate hemostasis or presence of spontaneous bleeding, the teeth were indicated for pulpectomy and were excluded from the study.

After the standardized technique for both the groups, the teeth were treated with a pulpotomy medicament assigned. After adequate hemostasis, cotton pellet moistened with 1:5 diluted Buckley's FC or *Aloe vera* gel was placed over the pulp stump for 5 minutes and then the pulp stumps were covered with thick mix of zinc oxide–eugenol (ZOE) paste and the teeth were restored with prefabricated stainless steel crowns (3M ESPE). Postoperative radiograph was taken, and the data were stored. The children were recalled for clinical and radiographic evaluation at 3 and 6 months follow-up. At the follow-up appointment, clinical examination was done based on modified Zurn and Seale criteria by the two outcome assessors who were blinded to the intervention. Radiographs were taken and compared with the pre-visit radiograph. Radiographic evaluation was also done by the two independent outcome assessors who were not a part of this study and blinded to the intervention groups. The scores were assigned based on modified Zurn and Seale criteria. Zurn and Seale criteria were based on clinical signs (pain, tenderness to percussion, abscess, swelling, fistula, and pathologic mobility) and radiographic findings (radicular radiolucency, internal and external root resorption, periodontal ligament (PDL) space widening, and furcation radiolucency).

### Statistical Analysis

The data obtained were subjected to a statistical analysis by using Student *t* test by using SPSS version 21.0 (SPSS, Inc., Chicago, IL, USA) with a *p* value set at 0.05.

## RESULTS

A total of 59 children were included for the study, based on the predetermined inclusion criteria, from October 2016 to November 2017. The study comprised of 43 (59.7%) males and 29 (40.3%) females. The age of the participants ranged from 4 years to 10 years (Table 1). The mean age of the participants was  $5.6 \pm 1.3$  years. In this study, mandibular first primary molars included were 34 with the percentage of 47.3% in both the groups and mandibular second primary molars included were 38 with the percentage of 52.7% (Table 1).

The teeth were clinically assessed for the presence of pain, percussion sensitivity, swelling, abscess, fistula, and pathological mobility. And radiographically, the teeth were assessed for the presence of PDL space widening, periapical resorption, internal and external resorption, furcation radiolucency, and pulp canal

obliteration. The presence of any one of the clinical and radiographic pathology was not considered a success. But, the presence of pulp canal obliteration was considered successful because it is indicative of radicular pulp tissue healing.

The inter-examiner reliability (IRR) of clinical and radiographic signs at baseline was analyzed by using Kappa–Cohen test and was found to have a substantial agreement between the two evaluators ( $k = 0.66$ ). To compare the clinical and radiographic success of FC and *Aloe vera* (AV) at 3 and 6 months follow-up, the average of the two evaluators' scores was considered for the analysis to find out the significance between the two groups.

At 3 months, a total of eight teeth (88.8%) were lost to follow-up. A total of 31 teeth in the FC group and 33 in the AV group were available for follow-up evaluation. At the end of 6 months follow-up, three teeth were lost to follow-up. A total of 30 in FC and 31 teeth in AV group were available for evaluation.

## CLINICAL SUCCESS

Table 2 depicts the clinical success rate for both the groups at 3 months and 6 months follow-up intervals.

At 3 months, there was 100% clinical success rate for FC group. In the AV group, one tooth had the presence of pain. The clinical success rate for AV group was 96.9%. Chi-square test showed that there was no statistically significant difference between FC and AV groups ( $p = 0.329$ ) (Table 2).

At 6 months, there was 96.6% clinical success rate for both the groups. One tooth in FC group showed presence of pain. One tooth in AV group was accompanied with clinical symptom of pain. There was no statistically significant difference between FC and AV group at 6 months ( $p = 0.981$ ) (Table 2).

## RADIOGRAPHIC SUCCESS

At 3 months, there was 67.7% overall radiographic success rate for FC group. Two teeth in FC group showed PDL widening and pulp canal obliteration. Three teeth showed furcal radiolucency, and one tooth showed periapical radiolucency. The overall radiographic success rate for AV group was 78.8%. In AV group, four teeth showed the presence of PDL widening and furcal radiolucency. Chi-square test showed that there was no statistically significant difference between FC and AV group ( $p = 0.895$ ) (Table 3).

At 6 months, there was 63.3% overall radiographic success rate for FC group. Six teeth in FC group showed furcal radiolucency, three-teeth showed PDL widening, two teeth showed pulp canal obliteration, and one tooth showed external resorption. The overall radiographic success rate for AV group was 54.8%. In AV group, seven teeth showed furcal radiolucency, five teeth showed PDL

**Table 1:** General characteristics of participants

Characteristics		<i>n</i>	Percentage
Age (years)	4	16	22.2
	5	21	29.2
	6	19	26.4
	7	10	13.9
	8	2	2.8
	9	4	5.6
Gender	Male	43	59.7
	Female	29	40.3
Mandibular	First primary molar (D)	34	47.3
	Second primary molar (E)	38	52.7

**Table 2:** Clinical success rate in the formocresol and *Aloe vera* group at 3 months and 6 months interval

Intervention group	Formocresol (%)	<i>Aloe vera</i> (%)	<i>p</i> value
3 months	100	96.9	0.329
6 months	96.6	96.6	0.981

**Table 3:** Radiographic success rate in the formocresol and *Aloe vera* group at 3 months and 6 months interval

Intervention group	Formocresol (%)	<i>Aloe vera</i> (%)	<i>p</i> value
3 months	100	96.9	0.329
6 months	96.6	96.6	0.981

widening, three teeth showed internal resorption, and one tooth showed pulp canal obliteration. Chi-square test showed that there was no statistically significant difference between FC and AV group at 6 months ( $p = 0.500$ ) (Table 3).

## DISCUSSION

Pulpotomy is the most common treatment for cariously exposed pulp in primary teeth. The intent of vital pulp therapy is to treat reversible pulpitis in order to maintain pulp vitality and function so that the primary tooth is preserved until natural exfoliation.

Preservation of vital radicular pulp tissue provides nutritive support to the teeth, helps in reparative capacity to form a dentinal bridge, which in turn maintains the integrity of the primary teeth.<sup>32</sup>

The success of pulpotomy usually depends on the ability of the pulpotomy medicament to adequately devitalize, preserve, and regenerate the remaining vital radicular pulp tissue through eliminating inflamed coronal pulp tissue.

The best-known pulpotomy technique for the past many decades is FC pulpotomy, which is established as the gold standard treatment in primary teeth. It remains the most widely researched agent for vital pulp therapy in primary molar pulpotomy, with a success rate ranging from 55% to 98%. It is a potent bacteriostatic and hemostatic agent to fix the radicular pulp tissue.<sup>33</sup> Hemostasis of the remaining pulp tissue leads to the greatest success of pulpotomy procedure.<sup>34</sup>

Its use in primary teeth remains controversial because it has been shown to be mutagenic, carcinogenic, and immunogenic. Cresol is a caustic agent, which is destructive to the vital pulp tissue.<sup>35</sup> FC, when absorbed systemically, causes potential injury to underlying permanent tooth bud.

Casas et al., reported that 54% of the pediatric dentists utilized FC pulpotomy for vital pulp treatment, and 42% of these specialists had concerns regarding FC.<sup>36</sup> Recently, in the view of development of newer pulpotomy medicaments, there has been increasing use of phototherapeutic agents for the treatment of various infections due to its excellent antimicrobial properties. Herbal plant extracts have been used since ancient times, but their application for oral applications is slowly emerging in the field of dentistry.

To overcome the problems associated with the use of synthetic medicines, there is an increasing shift in its use as a pulpotomy medicament because they are considered to have less potential side effects.

The herbal pulpotomy medicaments like *Allium sativum* (AS), turmeric, propolis, *Aloe vera*, *Elaeagnus angustifolia*, and honey have been investigated as pulpotomy medicaments in primary teeth.

*Aloe barbadensis* (*Aloe vera*) is a traditional plant most commonly found in the northeast of Brazil and tropical regions of India with a variety of medicinal uses. *Aloe vera* plant leaves are made up of three layers: an inner clear gel, which consists of 99% of water, rich in glucomannans, amino acids, lipids, sterols, and vitamins. The middle layer contains anthraquinones and glycosides. The outer rind has a protective action, which synthesizes proteins and carbohydrates. Abundant vascular bundles help in transportation of water and starch inside the rind of the *Aloe vera* leaf.<sup>37</sup>

Each part of the plant has some medicinal property, which has been used for the development of medicine against various diseases.<sup>38</sup> *Aloe vera* contains 75 potentially active constituents: vitamins, enzymes, minerals, sugars, lignin, saponins, salicylic acids, and amino acids.

The benefits of *Aloe vera* have been supported by its excellent antimicrobial, anti-inflammatory, regenerative, and wound healing properties.<sup>39</sup> In an animal model, Gala-Garcia et al., evaluated the effect of AV on rat pulp tissue and found that they have superior biocompatibility and potential to form tertiary dentinal bridge formation.<sup>40</sup>

In this research, we have utilized *Aloe vera* gel (group I), since it is well known for its multiple therapeutic functions such as wound healing, antimicrobial, anti-inflammatory, antiviral, antifungal antioxidant, potent analgesic, and immune-modulating properties.<sup>41,42</sup>

Initially, in the field of dentistry, the antimicrobial effectiveness of *Aloe vera* was tested, where it was proved to be effective against various microorganisms.<sup>43</sup> An animal study evaluated the antimicrobial activity of *Aloe vera* against microbes like *Streptococcus mutans*, *Enterococcus faecalis*, *Candida albicans*. They had also assessed the pulp cell viability when used as a direct pulp capping agent in rats, and they reported that fibroblast and osteoblast present in the dentin-pulp complex were viable after 24 hours.<sup>39</sup> The clinical studies of *Aloe vera* against the gold standard medicament FC are limited in primary teeth. Even though *in vitro* and animal studies have proven efficient for pulpotomy, randomized control trials have not been concluded to evaluate clinical success.

In the literature, there are only a few studies evaluating *Aloe vera* as a pulp dressing material. Until date, there is very less evidence proving *Aloe vera* as an effective pulpotomy medicament.<sup>31,44</sup> This research is aimed at evaluating the clinical and radiographic outcome of *Aloe vera* as a pulpotomy medicament in primary molars between the age group of 4–10 years.

The control used in this trial was FC as it is considered as the gold standard pulpotomy medicament and has excellent bacteriostatic and fixative properties, and it has a success rate ranging from 55% to 98% in primary teeth.<sup>45</sup>

This randomized clinical trial aimed at finding an effective herbal pulpotomy medicament, as a substitute to FC, *Aloe vera* gel was used due to its good antimicrobial properties. *Aloe vera* gel was prepared by extracting the pulp of *Aloe vera* leaf in a sterile condition and was filtered and stored in the refrigerator at 35°F. Freshly prepared *Aloe vera* gel was used in this study because it may undergo rapid oxidation when exposed to the environment and become contaminated with microbes and may have reduced antioxidant and anti-inflammatory properties. There were no adverse effects associated with *Aloe vera* gel in our study. Previous studies have evaluated the clinical, radiographic success, and histological effects of various herbal pulpotomy medicaments and only a few studies have tested *Aloe vera* as a pulpotomy medicament and found it to have comparable success rates and histological analysis reported *Aloe vera* to preserve the pulp vitality.<sup>31,44</sup>

Before the start of the treatment, the clinical and radiographic signs and symptoms were evaluated to consider it ideal for pulpotomy and teeth to be treated for pulpotomy was properly isolated using a rubber dam to prevent cross-contamination of the pulp canal space.<sup>46</sup>

In this study, pre and postoperative follow-up radiographs were taken by means of digital radiography using phosphor storage plates (PSP), which were stored and viewed in a monitor in order to avoid the problems associated with conventional radiographs and to maintain uniformity.

Among the clinical signs, tenderness on pain was assessed by using the handle of the mouth mirror, since it is the first clinical tool to



identify apical periodontitis and radiographic signs of the presence of PDL widening was examined as it is the first sign of infection of radicular pulp tissue and surrounding periodontal tissues.<sup>47</sup> In this study, the overall clinical success rate of FC pulpotomy at 3 months follow-up was 100%. And, at the end of 6 months follow-up, it has been reduced to 96.6%. The results were comparable to a study done by Peng et al., reported 100% success for FC.<sup>48</sup>

Yildiz et al., compared FC and MTA pulpotomy and reported that there was a greater success rate for FC.<sup>13</sup> In a recent study done by Hugar et al., reported FC to have 100% clinical success rate.<sup>49</sup> In contrast, Sonmez et al., reported a lower success rate of 76.9%. This could be due to the type of final restoration used, which helps in good sealing ability to prevent microleakage.<sup>50</sup> In this study, only one tooth in FC group in the 6 months showed failure due to the presence of intermittent pain while chewing foods.<sup>51</sup>

The overall clinical success rates in AV group was 96.9% at both three and 6 months follow-up. Two teeth had the presence of pain. The high clinical success rate could be due to the anti-inflammatory activity of AV, leading to the production of low levels of prostaglandins, which in turn control the pain pathway.

Davis et al., in an *in vitro* study, evaluated the anti-inflammatory activity of *Aloe vera* found that *Aloe vera* had broad-spectrum anti-inflammatory action in an animal model and stated that this was due to the presence of anthraquinones.<sup>30</sup>

In contrast, Gupta et al., reported 100% clinical success at 1-month follow-up interval based on Zurn and Seale criteria. The difference could be due to less time for the teeth to show clinical signs and symptoms.<sup>31</sup>

According to a study, comparing AV with MTA reported that there was only 75% clinical success rate of *Aloe vera* when compared with mineral trioxide aggregate. This may be due to the difference in the methodology of preparation of *Aloe vera* gel and placement of absorbable collagen sponge covering the *Aloe vera* gel since it is semisolid in nature.<sup>44</sup>

Another study evaluated clinical success rates of different herbal pulpotomy medicament; AS and FC and reported that four teeth (20%) in FC group showed clinical signs of pain and two teeth in AS group showed presence of pain accompanied with grade II mobility.<sup>51</sup>

In another study, the authors reported FC to have a 100% clinical success rate and Ankaferd BloodStopper to have 96.7% clinical success rate, but there was no statistically significant difference seen, which is similar to this study.<sup>52</sup> In a study, evaluating turmeric as a pulpotomy medicament in primary molars reported that only one (6.66%) reported pain after 6 months.<sup>53</sup>

Radiographic finding is considered most important to judge the prognosis of vital pulp therapy (AAPD). In the current study, the radiographic success rate for FC pulpotomy was 67.7% at 3 months and 63.3% at 6 months. This is in accordance with a study that reported 77% success rate at 6 months follow-up.<sup>54</sup>

At 3 months, four teeth in AV group showed PDL widening and furcal radiolucency. At 6 months, seven teeth in AV group showed furcal radiolucency. One tooth showed progressive internal resorption and was indicated for extraction. Similarly, a study done by Kalra et al., also had four teeth in AV group showed furcal radiolucency.<sup>44</sup>

The radiographic success rate of AV at the end of the 3rd month was 78.8%, but later at 6 months, the success rate decreased to 54.8%. This difference could be due to a decrease in the anti-inflammatory property of *Aloe vera* gel over a period of time. This was in accordance with another study, which reported that the

overall success rate of *Aloe vera* was only 57% when used as a pulpotomy medicament, and the failures increased when evaluated for longer periods of time.<sup>44</sup> Limitations of this current research are lesser follow-up interval and exact measures required to prevent oxidation of the *Aloe vera* gel is not done.

## CONCLUSION

Within the limitations of the study, the clinical and radiographic success rate of both AV and FC when used as a pulpotomy medicament in primary molars demonstrated, comparable effectiveness when evaluated for a period of 6 months, but was found to be statistically nonsignificant. However, further clinical studies with long-term follow-up and comprehensive histological studies to prove it as a promising substitute to gold standard conventional pulp dressing materials.

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